# THE SORPTION-SPECTROSCOPIC METHOD FOR DETERMINING CHROMIUM(III) IONS USING AN ORGANIC REAGENT

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***Annotation:*** *A sorption-spectroscopic method for determining chromium (III) ions in industrial wastewater was developed. The immobilization methodology was presented, and a suitable carrier for immobilization was selected. The dependence of the complex formation of chromium (III) ions with an organic reagent on the pH environment was studied. The structure of the complex formed with the immobilized nitrozo-R-salt reagent and the immobilization mechanism of the reagent onto the fiber were confirmed using X-ray fluorescence analysis.*

***Keywords:*** *sorption-spectroscopy, immobilization, nitrozo-R-salt, chromium, organic reagents, PPA fiber.*

Chromium exists in various forms in the environment, with its toxicity levels differing accordingly. In its hexavalent state, chromium is highly soluble in water, making it capable of easily contaminating water bodies and reacting with cellular components, thereby posing significant risks to human health. Long-term exposure to chromium can lead to several severe health issues, including microcytic anemia, damage to mitochondria, and the DNA of blood cells. This, in turn, may result in carcinogenicity, occupational asthma, heightened sensitivity of the respiratory system, and inflammatory diseases of the nose and eyes. Chromium contamination occurs not only at endemic levels but also through other

branches of the natural environment, such as food chains and transportation pathways.

Numerous studies are ongoing to reduce the level of chromium pollution in the environment [1]. The recommended daily chromium intake is 35 µg for men and 25 µg for women. However, for individuals over the age of 50, the daily dose is advised to be reduced to 30 µg for men and 25 µg for women [2].

At present, various organic reagents are used to detect heavy and toxic metal ions in wastewater and industrial effluents. There are numerous methods for determining chromium (III) ions. In this study, nitrozo-R-salt, an organic reagent containing a nitrozo group, was utilized to detect chromium (III) ions.

*Table 1*

**Selection of Optimal Carrier**

| **Fiber** | **A Before Immobilization** | **A, After Immobilization** | **ΔA** |
|---|---|---|---|
| PPA | 0,553 | 0,295 | 0,298 |
| PPD | 0,553 | 0,433 | 0,12 |
| PPF | 0,553 | 0,387 | 0,166 |
| SMA-1 | 0,553 | 0,424 | 0,129 |
| SMA-2 | 0,553 | 0,490 | 0,063 |
| SMA-3 | 0,553 | 0,465 | 0,088 |

Various carriers were selected to determine the optimal immobilized carrier. To prepare the carriers for immobilization, they were converted into their chloride form. For this purpose, 0.2000 g of each carrier was weighed using an analytical balance and immersed in 50.0 ml of 0.1 M HCl for 1 hour. Afterward, the carriers were washed 2–3 times with distilled water. The carriers, converted into their chloride forms, were then treated with the nitrozo-R-salt reagent to identify the optimal carrier. Based on the results presented in Table 1, PPA fiber was determined to be the optimal carrier.

To study the effect of buffer solutions on immobilization, 0.2000 g of the selected fiber was placed into a 50 ml beaker. An aqueous solution of 0.05 M

nitrozo-R-salt and 2 ml of 0.1 M manganese(II) and chromium(III) salt solutions were added. The mixture was stirred with a glass rod for 10 minutes, followed by the addition of 5 ml of different buffer solutions. The buffer solution was selected based on the differences in optical densities. The results are presented in Table 2.

Table 2.

**Effect of Buffer Solutions on Immobilization**

| | pH | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | R% | | | | | | | | | | | | |
| R+Cr+3 | Universal | 0 | 26 | 44 | 35 | 28 | 22 | 17 | 11 | - | - | - | - |
| | Atsetat | 0 | 9 | 15 | 29 | 25 | 17 | 6 | 9 | 8 | | | |
| | Fosfat | 0 | 11 | 16 | 23 | 28 | 25 | 14 | 13 | 8 | 6 | | |
| | Ammiak | 0 | 6 | 11 | 15 | 19 | 26 | 26 | 28 | 22 | 19 | 13 | 8 |

From the obtained results, it was observed that the universal buffer provided the best outcome for complex formation. Therefore, this buffer was selected for the experiment, and a pH range of 3–4 was chosen as the optimal environment for the process.

The optimal conditions for determining chromium (III) ions were identified. The use of polymeric carriers in the method resulted in an increase in the lower detection limit for chromium.

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ISSN 3060-4567

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